DOCUMENT RESUME

ED 115 224 IR 002 763

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TITLE The Problems of Using Systems Approach in General Education.
INSTITUTION Human Resources Research Organization, Monterey, Calif. Div. 3.
PUB DATE Jul 72
NOTE 17p.; Paper presented at the Annual Meeting of the California Association for Educational Media and Technology (San Diego, California, March 1972)

EDRS PRICE MF-$0.76 HC-$1.58 Plus Postage
DESCRIPTORS Behavioral Objectives; Curriculum Development; Educational Objectives; Individualized Instruction; Instructional Design; *Instructional Systems; *Systems Approach; *Systems Concepts; Teaching Methods

ABSTRACT

The first step in establishing an educational system is to assess the desired outcomes of the task and to state them as observable behaviors. The second step is to determine the optimal learning environment for the achievement of those goals. The final step is to set up a system of evaluating the quality of the instruction and the performance of the student so that the training can be corrected if it is in any way deficient. If the systems approach is to be successfully used, three preconditions must be satisfied: first, the goals of instruction must be identifiable; second, the process of instruction must be open to fundamental reorganization; and third, the goal must be achievable in a reasonably short amount of time. Difficulties are often encountered when a curriculum designer identifies only one course of action to achieve a goal, when in actuality there are many. The traditional teacher-centered model of instruction is also a frequent barrier to rearranging the educational environment. (EMH)

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The Problems of Using Systems Approach in General Education

by

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July 1972

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PREFATORY NOTE

This paper is based on a presentation given to the College and University Media Directors of California at their meeting during the convention of the California Association for Educational Media and Technology (CAET). The convention was held in March, 1972 at San Diego, California. Mr. Michaels is a Research Scientist with the Human Resources Research Organization, Division No. 3, Monterey, California.

THE PROBLEMS OF USING
SYSTEMS APPROACH IN GENERAL EDUCATION

Many of the things I will be talking about have been taken from my personal experience for the past two years.

After graduate work at Indiana University, I went to work for a nonprofit research organization, the Human Resources Research Organization, or HumRRO for short. Although the following description does not cover many of HumRRO's activities, I went to work there for the main reason that I felt it was one of the few places in the country where instructional systems were not only being talked about but actually being developed and used in the solution of instructional problems.

While at Indiana, I spent some time learning about the uses of media in education. But I spent much more time in a new area whose curriculum was just being worked out while I was there. That area was called instructional design and that label covered instructional design and that label covered instructional systems theory, the stuff and matter that Glaser[1], Gagne[2], DeCecco[3], Briggs[4], for instance, were recommending as the basis of a new educational philosophy. The major components of this approach are: specifying of objectives in behavioral

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[1]Leslie J. Briggs. *Sequencing on Instruction in Relation to Hierarchies of Competence.* Pittsburgh: American Institutes for Research, 1968.

[2]John P. DeCecco. *The Psychology of Learning and Instruction: Educational Psychology.* Englewood Cliffs, New Jersey, Prentice-Hall, 1968.

[3]Robert M. Gagne. *The Conditions of Learning.* New York: Holt, Rinehart and Winston, 1965.

[4]Robert Glaser. *Evaluation of Instruction and Changing Educational Models.* University of Pittsburgh, Learning Research and Development Center, 1968.

terms, designing of instruction by individualization through the use of media and computers, establishing entry requirements of the learner and finally, evaluating the whole instructional package. I am talking about those things which in a recent issue of *Audio-Visual Instruction* were called instructional technology. The evolution of the theories of instructional systems and the distinctions among them are not important for my purposes right now. (I will pick up this topic a little later on.) I would only like now to draw your attention to the fact that instructional systems have been generating a lot of discussion and controversy in education. The one topic of behavioral objectives, alone, has resulted in a massive controversy. The point is that while systems theory has been surrounded by a great deal of prose in the form of a scholastic debate over theoretical points, it has not resulted in much action in educational institutions. Nor has it yet been the basis of any wide scale reform and remodeling of the way education has been conducted in the schools.

I would have liked to say, now after two years' hindsight, that I knew that the educational revolution advocated by systems theorists would unfortunately be a paper one. That I knew all along that this would be the fate of systems in academic education and if I wanted to work with systems I needed to go to a research organization like HumRRO. Unfortunately, I was not that far-seeing two years ago about the contemporary status of instructional systems. Even at this point in time, the final dispensation of systems theory in education is not yet settled. It is clear in my mind, however, that the theories of instructional systems have to be expanded and reshaped if they are to

have any continuing impact on schools. And second, the ways we organize the learning process of kids in schools has to be drastically revamped if we are to make progress in using systems ideas.

It has taken me a while to introduce the main theme of this talk. I would like to go back and deal with these themes a little more systematically. The first theme is that systems theory has been successfully used by research organizations like HumRRO in solving training problems. Let me set the stage briefly; the Armed Services, business and industry maintain large instructional establishments, where very large sums of money are spent yearly. After World War II, in the early Fifties, psychologists were called in, especially in regard to the Armed Services, to help them improve instruction so that men would be better trained for the same amount of money, or hopefully for smaller sums. From the research and analysis these men did over a period of years, a generic method was cohered as a useful means of developing improved training strategies. This method was one of the primary sources for the later evolution of instructional systems theory.

This method in brief is still an apt summary of the basic ideas of systems theory: The first step in designing an instruction system is to sort out the purposes or the reasons for the instruction. We have to know what ends we are trying to reach through instruction. In the case of military and industrial short-term training, the ends of instruction were, in general, to prepare men for jobs that they were to be performing soon. The case for setting instructional objectives in these instances was straightforward: Find out what skills men have to have to perform on jobs, find those that they have to perform most

frequently, find out what level of attainment they need in order to perform the skills. And finally, ensure through quality control checks that men have indeed learned to perform the skills.

The foundation of the method is that there is an *empirical means* of deriving the objectives of instruction--through the empirical analysis of the tasks that any job is composed of. In order to perform the tasks, men need a set of skills. The closing of the loop thus becomes to ensure that men have mastered the skills they need in order to be successful performers on the job.

Task analysis also logically led to description of instructional objectives in terms of behavioral statements. It would have been both highly inappropriate and foolish to have done otherwise. Statements of objectives in terms such as, "Has an appreciation for the use of micrometer in American industry" and "Knows the history of the hammer in the trade union movement" would have been nonsensical.

Once the first step was completed, that is, once behavioral objectives were derived from an empirical task analysis of the skills comprising a job, then other steps fell into place. Instructional methods for teaching the skills could be derived from the context of the job: Give the man the tools and context he needs for learning the skills. Ensure that he has sufficient time to practice the skills so that he can become proficient in them. And finally, set up a system of evaluating the quality of the instruction itself and the performance of the man once he has completed instruction so that the training can be corrected if deficient in any way.

I have simplified the model and dealt with it rather quickly because no doubt you have been talked to death about the basics of instructional

systems. I reviewed these ideas only to show you that they can be successfully used--and this is the main point--under a set of specialized preconditions.

> The first precondition for success is that we have some objective and empirical means of deriving the purposes or goals of instruction.
>
> The second precondition for success is that the methods we use to teach students must be opened to fundamental reorganization, so that we can make use of the full possibilities of all instructional media, including teachers and libraries.
>
> The third precondition for success--though I am not as sure of this one as I am of the others--is that the objectives of an instructional system should be such that they can be realized within a relatively short period of time--weeks or months, rather than years.

We have been successful at HumRRO because we have used the systems approach under these three preconditions: We have worked out methods of determining objectives empirically. We are free to devise instructional methods without being limited to one model of instruction. We also deal with training systems of relatively short duration.

The second and main theme is why we have not been able to use these ideas--that is, any specific systems model--in academic education. There is some informal evidence against the use of systems in general education: The Rand Study on performance contracting was released about a month ago.[1] Performance contractors have been

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[1] G. R. Hall. *Performance Contracting in Education and the Rand/HEW Study*. Santa Monica, Ca: Rand Corporation, February 1972.

somewhat foolishly willing to put their money on the line, while the rest of the educational establishment has been willing only to put its mouth on the line. Systems ideas--such as self-pacing, behavioral objectives, learning modules, individualization, have been tried by these contractors and they seemingly have failed. The students taught by performance contractors did not achieve differently from control students, as measured by standardized tests. The contractors were foolish, first of all, by letting their instruction be evaluated under gains registered on standardized tests. The more serious error they committed was to place themselves in the usual context of schools without requiring any large-scale changes or adaptations. By analogy, they played baseball under basketball rules.

The second informal piece of evidence against instructional systems is simply the lack of them in schools. Fragments and isolated examples can be found here and there, but schools seem to be hiding in the woods warily observing the whole phenomenon without any sort of commitment. Teachers especially seem to dread the new supposed magic of behavioral objectives, especially when behavioral objectives are imposed on them without letting them have a voice in the matter.

I agree with their wariness. A lot of theoretical problems have to be worked out before I think we can see any broad and continuing adoption of the systems approach in general education. The first and most fundamental problem lies in how we structure the objectives of instruction. At first glance, the idea of stating objectives in behavioral terms seems simple and straightforward. But the more we examine the concept, the more problems we find. Whether it is reading, biology, social studies, psychology, at whatever level in school, we have supposedly a

series of long-term objectives to realize in general education--ones that may take students years to achieve. According to some proposals, such as Gagne's and Briggs', these long-term objectives--like learning to read--should be converted into series or sequences of short-term objectives. The sequence of short-term objectives is then to be arranged in a hierarchy of skills or behaviors which will lead the student to the long-term objective. The hierarchy might go something like this for learning to read: In kindergarten there would be a first set of abilities all students would have to learn. Once these are mastered, the students are to move to the second level and so on through the hierarchy until they all read at a certain speed, at a certain level of comprehension with certain materials.

The premise is false. We simply do not know enough about how people learn to concisely structure how they are progressing through instruction over a long period of time. Further, I suspect that there is no one path that all must follow undeviatingly in order to learn. It is impossible, I think, to say at the present time that in order to learn "X" we must proceed through steps A through J, let us say, in that sequence. A hypothetical learner might want to and be capable of beginning at C, group steps D, E, and F together to learn to do this "X." Thus, one extensive problem with behavioral objectives is that theorists want to place them in a hierarchy through which all students must progress in a linear fashion.

I don't want to belabor this point too much, but it is a crucial one. We cannot continue to make learning so close-ended that our chief purpose in education is to prescribe one sequence, one series of steps that

everybody must go through over an extended period of time in order to learn anything. That is the ultimate end, I fear, of the placing of behavioral objectives on an invariant hierarchy.

So far, the first crucial precondition of using instructional systems has not been met. We cannot build from the base of a validated learning theory a hierarchy of objectives, in which to encase long-term instruction, a condition we encounter frequently in general education. There are many competing learning theories, and no one of them is the clear victor over the others in prescribing what sequence of steps a learner must go through in his learning.

Without this base the use of behavioral objectives is ultimately futile in a hierarchy that all students must follow, because we have no way to decide how to arrange behavioral objectives in a sequence that would take a considerable period of time to accomplish.

While I have built the case against trying to place behavior objectives in an invariant sequence in regard to long-term, complex educational goals, there remain many areas of education which resemble training, in all but name. In areas such as learning to type, learning to use a camera, to mount a slide, behavioral objectives are useful and can be arranged in a possible learning sequence through task analysis and empirical validation where students can learn to perform discrete, short-term skills. Even in those areas where we are dealing with short-term skills, there are problems.

To discuss these problems, I would like to turn to the second precondition of using the systems approach in education, namely the freedom to rearrange instructional methods in order to achieve a set of short-term objectives. As you all probably know, the resistance to

change in education is formidable. People working with educational media have had a hard time simply getting a slide projector or a film into the classroom. They have been successful only insofar as they have adapted media to fit around the traditional classroom structure and to fit around the teacher.

The most prevalent model of instruction in the schools is the teacher-centered model. The teacher orchestrates all the activity in the classroom and is the one who does the most talking, performing, questioning and answering. He, in fact, is the star. In colleges and universities, the lecture is the chief method of conveying information to the students. The lecturer talks throughout the semester and the students supposedly listen. Thus, even the implementing of systems ideas in short-term instruction poses many problems in regard to the traditional model of classroom instruction.

If we are to make even small changes, such as individualizing instruction through self-pacing, many educational routines such as 45-minute periods, grade levels, testing, would have to be abolished. To give you some idea of the scope of the problem, a study by Patrick Suppes[1] of Stanford on computer-assisted instruction illustrated a major problem in self-pacing. Over a period of months, students were allowed to learn at their own rate. At the end of this time, the bright students had completed about four times as much material as the slow learners. Just self-pacing alone would cause a major disruption in school routines as they are now constituted.

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[1]Patrick Suppes. "Mathematical concept formation in children." *American Psychologist*, 1966, 21, 139-150.

A far more serious problem is posed by the traditional paradigm of the instructor-centered classroom. A systems approach would change the focus of instruction from the teacher to the student. The teacher's main role would no longer be the conveyor of information but the manager of instruction, helping students organize their own learning, providing materials to the learner, and serving as a guide-counselor. To change the basic role of the teacher would have far-reaching ramifications in academic routines, academic costs, and academic materials. Any disaccommodation of a large vested interest, the teachers themselves, means the decision would have to be worked out through political processes of negotiation, possibly strikes, and ultimately compromises. A quick illustration of the problems can be taken from the negotiations in New York City between teachers and administrators when the community wanted to take charge of the schools, about how teachers react when there are large changes in their roles. They went out on strike when thus threatened. Because the systems approach would require a basic freedom to deviate from the teacher-centered classroom, I have the strong fear that the installation of systems ideas in schools will be surrounded by a vast political controversy.

The final precondition that has not been met deals with the length of the instruction attempted under the systems approach. When it is confined to instruction of realtively short duration, it has been successful in training men to perform jobs, learn skills--in short, to become competent job performers.

Whether or not we can handle very large blocks of instruction in this way is still open to question, even in training, let alone in

general education. I want to review briefly an earlier point. If we go the route of placing behavioral objectives in a linear sequence, then we essentially prescribe the route all learners must follow when they learn. I tried to show earlier that we lack the theoretical base from psychology to organize learning in this way.

Even if the theoretical base were there, to attempt to organize a whole year's instruction in some highly cognitive area, like learning to read, would be massively complex and highly expensive. A brief example: A project HumRRO has been involved in the past three years was to restructure training of field wiremen in the Army through peer instruction. The course is only eight weeks long, but it took us three years to study the problem and work out an ideal instructional model that the Army could implement for all training in non-combat courses. If we were to attempt to directly apply the systems approach as it now stands, to restructure general education, we would have to take many years and spend a great deal of money. And it's hard to see right now a huge infusion of funds for such projects in education.

Review

By way of review, let me talk about the changes that I feel are necessary if we are to use the systems approach in general education. The changes that are necessary, of course, flow from the three pre-conditions outlined earlier. The first thing we must change is the way behavioral objectives are used in education.

I think it is quite correct to specify in clear, precise terms what skills and abilities the learner should have acquired as a result of instruction. Quite often in the past, school instruction has lacked a

focus and has not examined in a strict sense what students are expected to do as a result of instruction. We have too often thought about teaching only a certain content, only some body of knowledge. And, we have forgotten that our job is to equip students with skills and capabilities, and more importantly, that the student should be an active participator in the instructional process. Let him talk, write, work with ideas, find his own way, instead of sitting him passively in front of a podium and having a lecturer present him with digested information.

The change in the way we use behavioral objectives that is required is to free them from a detailed hierarchy that spells out what someone is to learn in a linear fashion--much in the fashion of linear small-step programming. Instead, we have to permit the larner to get to the objective in his own fashion. We should not guide his learning at every stage and at every turn and jolt in the road. We should permit him options and permit him to structure his own learning in his own way, while at a distance we are helping him to grow to a new capability or skill.

The second way that we must extend the systems approach for its use in general education is to free it from the routines and present academic organization of schools. If we must adapt this innovation to the classroom, as we have had to adapt educational media so that it fits in with the teacher-centered classroom, the game is lost before it even begins. This sort of classroom, with the teacher as the star performer instead of the students, needs to be disestablished if we are to restructure general education. If we are to permit students to work at their own pace, learn with materials that are most comfortable to them, fashion

their own learning steps, then the traditional classroom is a deterrent and a hindrance. If this is not done, however, then we take the very vitality and vigor out of the systems approach because academic routines and organization will dilute the strength of the innovation and reduce it to a pale reflection.

The third thing that must come to an abrupt halt is the long-term structuring of the curriculum. Instead, we need to think of education as an individual's acquisition of abilities and skills. For example, instead of teaching a student geography, we need to teach him certain skills--and knowledges--under the umbrella of geography, so that we can permit him to acquire sets of short-term skills--which might lead to other skills--and so on. Our way presently is to teach the student, geography or whatever, over a course of an extended time period. We don't think of skills. We don't think of what the student is able to do after this period of time. We only think of the time involved and the knowledge he is to digest.

But, if we conceived of the purpose of instruction as the acquisition of skills over a short period of time, which the student can extend and use in more complex ways and with more complex content as he continues his education, then we have no need of 12 years of English and 4 years of math and 3 years of science. We can point to this skill acquired and that capability acquired as the result of instruction and years spent in education. All this is more preferable in my mind than the units in English or two years of French which now high school students bring to college and with which college students get their degrees.

I want to end by saying that systems theory, as it presently stands and is conceptualized, is not very useful in general education.

The systems theory needs to be broadened and extended if it is to be of any use. Behavioral objectives, for a crucial example, can not be tied to a specified, linear hierarchy that all students must conform to in their learning, as psychologists working on systems theory want to do. Second, we need to extend the theory by working out how the logistical problems of instructional modules, self-pacing and individualizing instruction might be solved in general education.

If these changes can be made in the systems approach, then I think we will be over this transitional period and can extend systems approach to general education. Without these fundamental changes, both in theory and practice, I think the systems approach will die an early death--with no mourners and no regrets.